Noise-driven Alfvén intermittency in the magnetosphere

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The POLAR spacecraft has demonstrated recently that large-amplitude Alfvén waves observed in the plasma sheet boundary layer (PSBL) may transport energy from the distant magnetotail to the auroral acceleration region during geomagnetic active periods (Keiling et al., 2005). In this paper, the intermittent nature of magnetosphere is investigated by adding noise to numerical simulations of nonlinear Alfvén waves described by stationary solutions of the derivative nonlinear Schrödinger equation (Chian et al., 1998; Borotto et al., 2001; Rempel and Chian, 2005). The study of intermittency is crucial for the understanding of the physical processes underlying the Alfvén wave propagation in the magnetosphere, where the coexistence of multiple steady states (multistability) can lead to complex plasma dynamics when a stocastic source is considered. By using chaos theory, it is shown that the Alfvén intermittency can be seen as a competing behavior, where the action of external noise triggers the hopping between the different coexisting attractors (Rempel et al., 2006). The role of nonattracting chaotic sets known as chaotic saddles (Rempel et al., 2004) in the hopping dynamics is discussed. Since noise sources are always present in magnetosphere, it is plausible that the intermittent phenomena observed in real magnetospheric data are in fact a signature of multistable regimes in the presence of noise.